

GRAMMA LINKI: A NEW SPECIES OF GRAMMID FISH FROM THE TROPICAL WESTERN ATLANTIC

Walter A. Starck, II, and Patrick L. Colin

ABSTRACT

Biological investigations of deep outer reef faces by manned submersibles and deep diving techniques have yielded collections and observations of a previously undescribed species of the West Indian genus *Gramma*, a genus of fishes usually referred to the family Grammidae or to a more inclusive Serranidae. This fish is apparently a common and widespread element of the outer reef face fauna of the Bahama Islands and Caribbean area. The three species of *Gramma* tend to replace one another with depth with *G. linki* occurring generally below 60 m where it occurs with *G. melacara*. Where *G. melacara* does not occur in the eastern Caribbean, *G. linki* can occur considerably shallower.

The steep outer face of coral reefs is a biologically rich yet poorly known habitat. Generally beginning at depths of 30-60 m such faces of reefs are often vertical or nearly vertical in profile and highly eroded, possibly due to varying sea level during the Pleistocene. As such, they afford a relatively silt free foundation for the attachment of sessile organisms and abundant shelter for mobile creatures. Currents are usually present along these faces and an abundant fauna of sponges, bryozoans, cnidarians and other filter feeding animals occurs. The fish fauna of these areas is less diverse and abundant than that of shallower reef zones, but has many elements unique to this habitat. Over one half of the characteristic species seldom or never venture into other areas, a degree of specific differentiation markedly greater than any other part of the reef.

On West Indian reefs the outer face zone (the "dropoff" of diving terminology) has a rich blanket of sessile organisms from its start at 30-60 m to depths of 100-120 m. The cover of organisms gradually diminishes down to about 180 m and below that depth the substrate is predominantly barren. From 120-180 m the reef associated fauna gradually merges with a deeper fauna not necessarily associated with coral reefs.

Few published studies exist regarding the zonation of steep outer faces of West Indian reefs. Lang (1974) and Hartman

(1973) discussed biological zonation of the outer reef zone (deep fore-reef of Lang) at Discovery Bay, Jamaica, and Porter (1973) reported on observations made in the Bahamas. The only published accounts of *in situ* observations of fishes in such areas in the western Atlantic are those of Colin (1974, 1976).

The outer reef zone is most diverse at its upper limit where the fore reef slope becomes abruptly vertical at 30-60 m depth. Where the vertical face begins relatively shallow some elements of its characteristic fauna still occur, but are often mixed with shallow reef species. Where the outer reef face is less steep below 50-60 m, shallow water species extend deeper and the delineation of zones is also less distinct.

The outer reef face below 50 m is poorly known for a variety of reasons. Its fauna is nearly impossible to adequately sample by trawls or dredges as it is too steep and rugged and is largely beyond the depth limits of effective compressed air Scuba diving. Recent advances in diving technology, however, have begun to make this region accessible to biologists.

In February 1968 the senior author participated in a program of the Smithsonian Institution using the diver lock-out submarine *Deep Diver* developed by Edwin Link. During these operations several individuals of a new fairy bass of the genus *Gramma* were

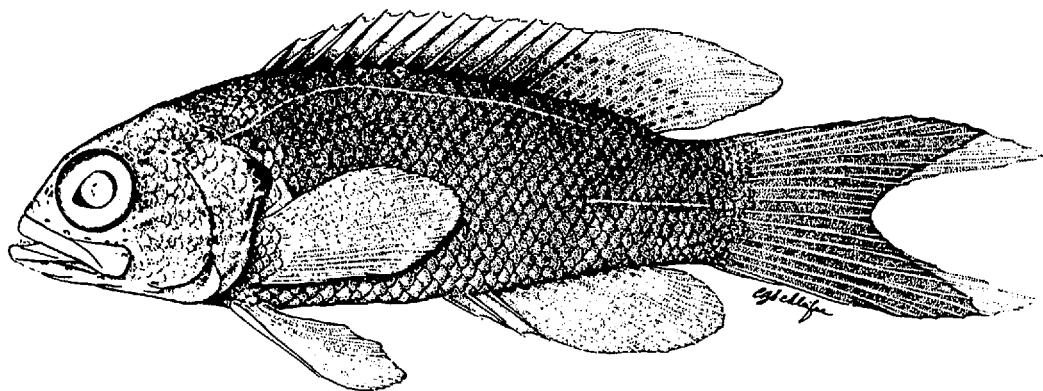


Figure 1. *Gramma linki*, composite drawing based mostly on American Museum of Natural History (AMNH) 35775, Freeport, Grand Bahama Island, standard length approximately 40 mm. Illustrated specimen has only 9 soft dorsal rays while having XIII dorsal spines, an unusual combination. The stippled area on the caudal fin are rays which were incomplete on AMNH 35775. The illustration is by Carol Gene Schleifer.

observed at close quarters from the sub at a ledge 3–4 m wide running along a vertical section of reef face at a depth of 65 m off Fresh Creek, Andros Island, Bahamas. Fortunately the location proved suitable for a lockout dive and a subsequent rotenone collection yielded 13 specimens of the new fish.

During the same program the senior author made the acquaintance of Dr. John Kanwischer of Woods Hole Oceanographic Institution out of which grew the development of a self-contained closed circuit mixed gas breathing apparatus (Starck, 1969). This apparatus made possible the collection of subsequent material of the new species under a more extensive program of investigation of the outer reef zone supported by the National Geographic Society.

Gramma linki new species

Figures 1–3

Gramma sp., Colin 1974: 31, 34–35; 1976.

Diagnosis.—Dorsal fin count XIII, 10 or XIV, 9; anal fin count III, 10–11; pectoral fin count nearly always 17, occasionally 16 or 18. Length of pelvic fin 26–34% of standard length. Body grey to grey blue with a yellow dot on each lateral scale. Several

horizontal yellow lines on the side of the head behind and below the eye.

Description.—The generic description of Böhlke and Randall (1963: 34–35) applies except as added to or modified by the following. The genus *Gramma* is referable to the family Grammidae or to a more inclusive Serranidae.

Interorbital nearly flat. A narrow elongate supramaxillary present along the dorsal exposed border of the maxillary.

Palatine teeth uniserial posteriorly, biserial anteriorly with a reduced inner row. Vomerine and palatine teeth continuous in external appearance. Teeth on vomer biserial with a reduced inner row. Two premaxillary teeth are noticeably enlarged. One occurs on each premaxilla near the median end at the posterior edge of the tooth patch. They are strongly retrose and only slightly smaller than the outer canines.

The lateral line is disjoint. The upper anterior segment terminates near or slightly anterior to the midpoint of the soft dorsal. The posterior midlateral segment begins at about the level where the anterior segment terminates and continues to the base of the caudal or one scale beyond. Most of the

scales above the anterior lateral line and on the chest and belly are cycloid. Those on the lateral and posterior portions of the body are ctenoid except for a few cycloid scales anteriorly on the sides. Scales cover the basal portion of the caudal fin and extend out onto the rays of the upper and lower lobes for about one-third of their length. A lesser portion of the median caudal rays are covered by scales. The scales on the head are cycloid with the exception of a few weakly ctenoid ones on the lower portion of the operculum. There are four to five scale rows on the operculum at its widest point and about eight on the cheek from the eye to the posteroventral margin of the preopercle.

The pectoral fins reach to about the level of the anterior insertion of the anal-fin in adults and slightly more posteriorly in young fish. The pelvic fins are moderate in length reaching to about the anus or the origin of the anal fin. The second and third segmented rays of the pelvic fins are subequal and longer than the remaining rays. Together they form the posterior tip of the fin. The posterior lobe of the anal-fin is produced into a short pointed tip or rounded. The posterior lobe of the dorsal-fin is more noticeably prolonged but not as greatly as in *G. melacara*. The first dorsal spine is shortest, the remainder subequal in length. The caudal-fin is deeply lunate with the lobes more or less subequal. The lower lobe has a tendency to be slightly longer. The caudal lobes are pointed. In one specimen they are produced into filaments about half as long again as the rays are normally. There are 17 principal caudal rays and 13 to 15 branched ones. Fifteen is the number in larger fish while smaller individuals generally have fewer.

Counts and proportions are as follows. Dorsal and anal spine and ray counts differ between specimens from Cozumel Island and those from the Bahamas and Mona Island. All five of the Cozumel specimens have a dorsal count of XIV, 9. Fifteen of the

Bahamian-Mona Island specimens have a count of XIII, 10 and only one (from Andros Is.) has XIV, 9. Four of the five Cozumel specimens and both Mona Island ones have a III, 11 anal count. Only one from Cozumel has III, 10 whereas all 14 of the Bahamian individuals have III, 10. Böhlke and Randall (1963: 39-40) also found differences in certain characteristics in *G. loreto* from different areas. No other significant differences in morphometric or meristic data were found in *G. linki*.

Eighteen specimens have 17 pectoral rays in both fins. One has 16-17; one 17-18 and one is 18 in both fins.

The remaining counts and proportions are based on all 21 specimens listed as type material except in the three instances noted where slight damage did not permit taking accurate data on all specimens. The range for each character is given as a hyphenated figure followed by the mean in italics and the figure for the holotype in parenthesis.

All specimens have I, 5 pelvic rays. Total gill rakers are 30-35, 33(33). There are 17 principal caudal rays in all specimens. Thirteen to 15 are branched with the fewer number in smaller specimens. The anterior segment of the lateral line has 27-35 pored scales, 30(27); and the posterior segment has 6-13, 10(11) based on 15 specimens. There is a distinct tendency for the number of pored scales in the posterior segment of the lateral line to increase with size of the individual. Lateral scales in 19 specimens were 35-42, 38(37).

The following body proportions are expressed as a percentage of standard length rounded to the nearest whole number. Head length is 30-37, 34(35); eye diameter 10-16, 12(10); snout length 5-8, 7(7); maxillary length 15-19, 17(17); interorbital width 7-9, 8(8); greatest depth of body 28-35, 32(34); depth of caudal peduncle 14-17, 15(17); length of pectoral fin 23-30, 26(28); and length of pelvic fin 26-34, 29(30). The last proportion is based on 20 specimens.

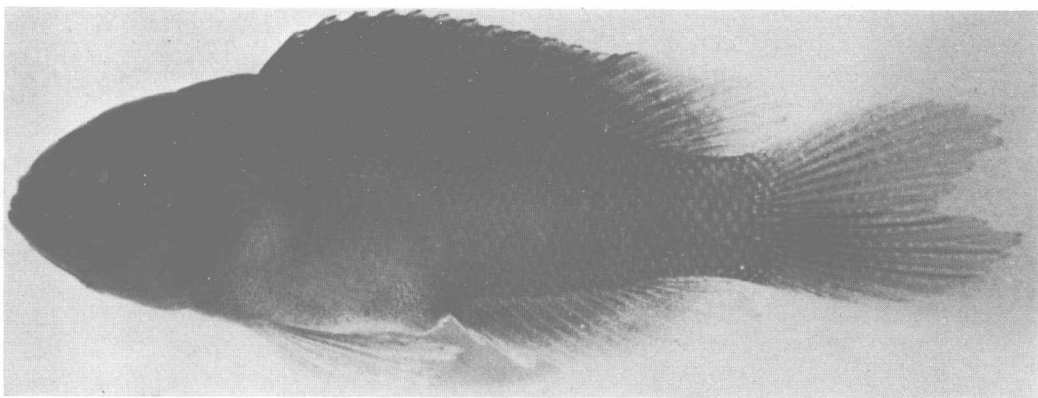


Figure 2. Juvenile individual of *Gramma linki* from UPR 3417, 16.8 mm S.L., Mona Island. The yellow lines behind and below the eye are faintly visible.

Coloration.—Freshly collected specimens are grey to blue grey with prominent irregular yellow lines on the head and numerous regularly spaced yellow dots on the body. There are no black markings in this species as in the other two species of *Gramma*. The grey ground color includes the dorsal, caudal and anal fins which are otherwise unmarked. The pectoral fins are colorless and the pelvic fins white. The ventral side of the body is pale grading into the grey ground color over the lower three to four scale rows. The intermediate area is tinged with magenta. The most conspicuous markings are a series of irregular horizontal yellow lines on the sides of the head. Of these the line running just beneath the eye to the tip of the opercle is the broadest, longest and most conspicuous. It is about the same width as the pupil. The remaining lines, one above and three below the sub-orbital line, are about half or less as wide as the sub-orbital one. The scales of the sides of the body each have a sharply defined yellow dot at the center. The dots are larger and more distinct than those of *G. melacara*. Small individuals of *G. linki* also have the yellow lines on the head, but they are fewer in number. A 16.8 mm standard length individual from Mona Island (UPR 3417) has only 3 visible on each side of the head with the uppermost one barely so (Fig. 2). The

smallest specimen collected, 12.7 mm S.L. (UPR 3418) had at least some yellow on its opercular area when alive.

Specimens observed at close range with a flashlight through the view ports of DEEP DIVER showed the same distinctive yellow markings but the ground color was paler and more olivaceous. The ground color was broken by several irregular pale bars on the body. The specimens were seen resting in cavities on the underside of an overhanging ledge and the pale bars are undoubtedly a resting pattern serving to break up the outline of the immobile fish. Numerous other fishes show similar irregular bars while at rest. Such bars also occurred on aquarium maintained specimens when frightened.

Distribution.—*Gramma linki* is known from Cozumel, Mona Island (Puerto Rico) and the Bahama Islands (Little Bahama, Great Bahama and Cay Sal banks) on the basis of specimens. It has also been recorded from Jamaica and British Honduras (Belize) on sight records (Colin, 1974).

Habits and relationships.—*Gramma linki* is more cryptic, less abundant and is generally found deeper than the other two species of the genus. *Gramma loreto*, the shallowest living species, occurs from depths of 1 m to over 30 m commonly and has occasionally

been found as deep as 60 m. It lives around large coral heads and about steep ledges, overhangs and caves. *Gramma melacara*, restricted to the outer reef face, is normally most abundant between depths of 35 to over 100 m, but does occur deeper and shallower under certain conditions. Where the vertical outer reef face begins at lesser depths it may occur as shallow as 10 m and at the other extreme individuals were seen as deep as 180 m from DEEP DIVER. Both species often form loose aggregations of up to a dozen or more individuals a few tens of centimeters from the substrate while they feed on plankton. The individuals are frequently oriented more or less vertically and under overhangs are usually upside down.

Almost all specimens of *G. linki* seen or collected in the Bahamas and the western Caribbean, where *G. melacara* also occurs, have been found at depths of 60 to 90 m. A single specimen was seen at Cozumel at 35 m in the roof of a large undercut and one individual has been recorded from a "blue hole" on the Cay Sal Bank, Bahamas at 23 m. Colin (1974) recorded *G. linki* as common at 103–130 m off Discovery Bay, Jamaica and at 90–110 m near British Honduras. At Mona Island, near Puerto Rico, where *G. melacara* does not occur, *G. linki* occurs at depths of 27–30 m and below in considerable numbers and overlaps slightly in its bathymetric range with *G. loreto*.

The three species of *Gramma* tend to replace one another with increasing depth and in a given locale there is usually only a slight overlap in the occurrence of each species. All three species occur in the Bahamas and the western Caribbean, but *G. melacara* has not been found in the Lesser Antilles despite extensive diving in suitable habitats. The most easterly record of *G. melacara* from the northern Caribbean is from the eastern end of Hispaniola (Colin, 1971: 22) and the southern Caribbean from near Cartagena, Colombia (Palacio, 1974: 45). Randall (1963: 78) also commented on the absence of *G. melacara* from various islands in the eastern Caribbean. The record of *G.*

melacara from Curacao, mentioned by Colin (1974: 34) has yet to be verified by a specimen. The absence or at least relative rarity of *G. melacara*, which in many reef areas is the most common fish below 50 m depth, from the eastern Caribbean is a distributional anomaly for which we can offer no explanation at present.

Gramma linki is not a conspicuous fish. In approximately 100 SCUBA dives by the senior author in the western Caribbean and Bahamas in the depth range and habitat of this species it was observed only once as mentioned above. On the one additional occasion from the submarine several isolated individuals were resting in overhead niches in an upside down position. *Gramma melacara* in contrast is a conspicuous and abundant species seen in quantity on every dive in the same habitat.

Ten dives to depths of 90–100 m along the same reef faces also failed to produce additional sightings as did a night dive to 55 m. The species was absent from over 20 additional rotenone collections along the same reef faces at depths of 35 to 60 m.

The stomachs of 10 specimens examined all contained fragmentary remains of crustacea. The more complete remains in one instance appeared to be amphipods and in three cases harpacticoid copepods. Apparently *G. linki* is a predator on the small plankton-like crustaceans that maintain themselves on the reef and seek shelter in caves and crevices. This fauna has been discussed by Emery (1968).

A number of specimens have been captured alive at Mona Island using a solution of quinaldine-alcohol and the species has proven hardy in the aquarium. As of this writing, one specimen has been maintained over 8 months in the laboratory. While suitable, the subdued coloration of *G. linki* will not make it popular in the aquarium trade.

Etymology.—It is a pleasure to name this new species after Mr. Edwin Link whose imaginative developments in undersea technology and generous support of marine sci-

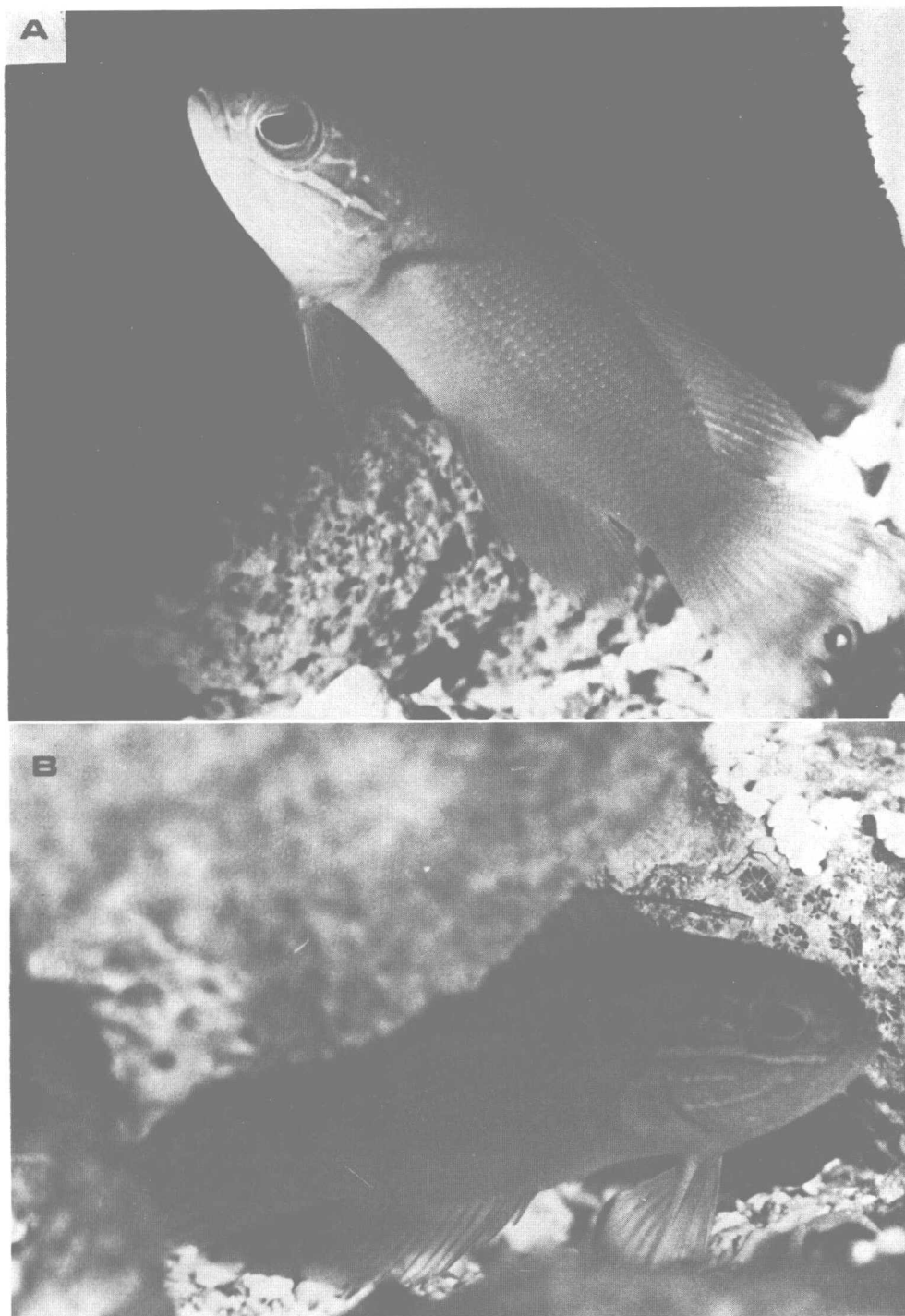


Figure 3. a and b: Live specimen of *Gramma linki* photographed in an aquarium. Standard length about 40 mm.

ence have made untouched realms of the sea accessible to marine science.

Material examined.—Holotype. ANSP 117314 (1, 56.6), Mexico, Cozumel Island, dropoff west of airport, 70–80 m, El Torito 1–9, 22 Oct. 1968, W. A. Starck II and William Schwicker.

Paratypes. ANSP 117315 (2, 59 and 42), taken with the holotype; USNM 205946, (1, 52), taken with the holotype; UMML 29140 (1, 48), taken with the holotype; ANSP 117312 (13, 24–45), Bahamas, Andros Island, dropoff east of northernmost rocky cay off Fresh Creek, 65 m, 22 Feb. 1968. W. A. Starck II; ANSP 117313 (1, 37), same location as preceding, 55 m, El Torito 3–22, 20 Dec. 1969, Jo D. Starck and Peter Hopper; UPR 3282 (2, 38 and 50), Puerto Rico, Mona Island, Piedra de Carabinero, vertical dropoff 33–40 m, 14 April 1975, P. L. Colin.

Additional material examined not designated as type material.

UMML 32933 (1, 41.5) Bahamas, Cay Sal Bank, Blue Hole Damas, 23 m, 15 April 1976, J. Meyers and J. Senecal; UPR 3417 (3, 16.8–41.0) Mona Island, Piedra de Carabinero, 57 m, 8 July 1976, P. L. Colin; UPR 3418 (5, 12.7–40.5), Mona Island, Piedra de Carabinero, 27–33 m, P. L. Colin, maintained alive in aquaria; ANSP 13446 (formerly UMML 30244) (1, 34.5), Bahamas, Cay Sal Bank, 16–71 Dec. 1971, via B. Palko.

ACKNOWLEDGMENTS

After preparing an initial manuscript describing this species the senior author became involved in extensive work in the western Pacific and had still not submitted it for publication when the junior author, during faunal work on the fishes of Puerto Rico, collected and observed the same species at Mona Island. The authors pooled their information and prepared the final manuscript for publication. Shortly thereafter they were contacted by C. Lavett Smith who had also collected the species near Freeport in the Bahamas and had prepared a description in cooperation with Robert Jones. Dr. Smith generously offered the use of his material including an excellent illustration prepared by Carol Gene Schleifer which appears herein and for which the authors are most grateful.

The specimens examined are deposited in the collections of the Academy of Natural Sciences of Philadelphia (ANSP), the University of Miami School of Marine and Atmospheric Sciences (UMML), the University of Puerto Rico, Mayaguez (UPR) and the United States National Museum (USNM).

The authors wish to express their appreciation to Mr. Edwin Link and Mr. Seward Johnson for making possible the Smithsonian program and for

support of marine science and technology in general. Thanks are also expressed to Dr. Richard Rosenblatt who was originally scheduled for that phase of the program and who volunteered his position to the senior author. The support of the senior author's coral reef studies by the National Geographic Society is gratefully acknowledged. Various aspects of this work were carried out from the authors' respective research vessels, R/V EL TORITO and R/V CORALLINA.

LITERATURE CITED

- Böhlke, J. E., and J. E. Randall. 1963. The fishes of the western Atlantic serranoid genus *Gramma*. Proc. Acad. Nat. Sci. Phila. 115: 33–52.
- Colin, P. L. 1971. Additions to the marine fish fauna of Jamaica with notes on their ecology. Carib. J. Sci. 11: 21–25.
- . 1974. Observations and collections of deep-reef fishes off the coasts of Jamaica and British Honduras (Belize). Mar. Biol. 24: 29–38.
- . 1976. Observations of deep-reef fishes in the Tongue of the Ocean, Bahamas. Bull. Mar. Sci. 26: 603–605.
- Emery, A. R. 1968. Preliminary observations on coral reef plankton. Limnol. Oceanogr. 13: 293–303.
- Hartman, W. D. 1973. Beneath Caribbean reefs. Discovery 9: 13–26.
- Lang, J. C. 1974. Biological zonation at the base of a reef. Amer. Sci. 62: 272–281.
- Palacio, F. J. 1974. Peces colectados en el Caribe colombiano por la Universidad de Miami. Bol. Mus. del Mar 6: 3–137.
- Porter, J. W. 1973. Ecology and composition of deep reef communities off the Tongue of the Ocean, Bahama Islands. Discovery 9: 3–12.
- Randall, J. E. 1963. Three new species and six new records of small serranoid fishes from Curacao and Puerto Rico. Stud. Fauna Curacao and other Carib. Is. 19: 77–110.
- Starck, W. A., II. 1969. Deep-diving Scuba. Oceans 1: 45–48.

DATE ACCEPTED: September 10, 1976.

ADDRESSES: (W.A.S.) Box 10, Kira Kira, Solomon Islands; (P.L.C.) Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico 00708.

ADDENDUM

Subsequent to submission of the manuscript, specimens of *G. linki* have also been collected from the island of Puerto Rico and St. Croix, U.S. Virgin Islands. The Puerto Rican specimen is from 55 m depth off Salinas de Ensenada, southwestern Puerto Rico, while the St. Croix specimen is from 27 m depth at Cane Bay on the north coast. Numerous other specimens were observed, but not collected at both of these localities.